



Vapor Intrusion: Emerging Real Estate Topic

Indiana Brownfields Conference 2006

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What is Vapor Intrusion?

Definition: Vapor Intrusion (VI) is the migration of volatile chemicals from the subsurface into overlying buildings (U.S. EPA Draft VI Guidance, November 2002).



VI – Common Contaminants of Concern

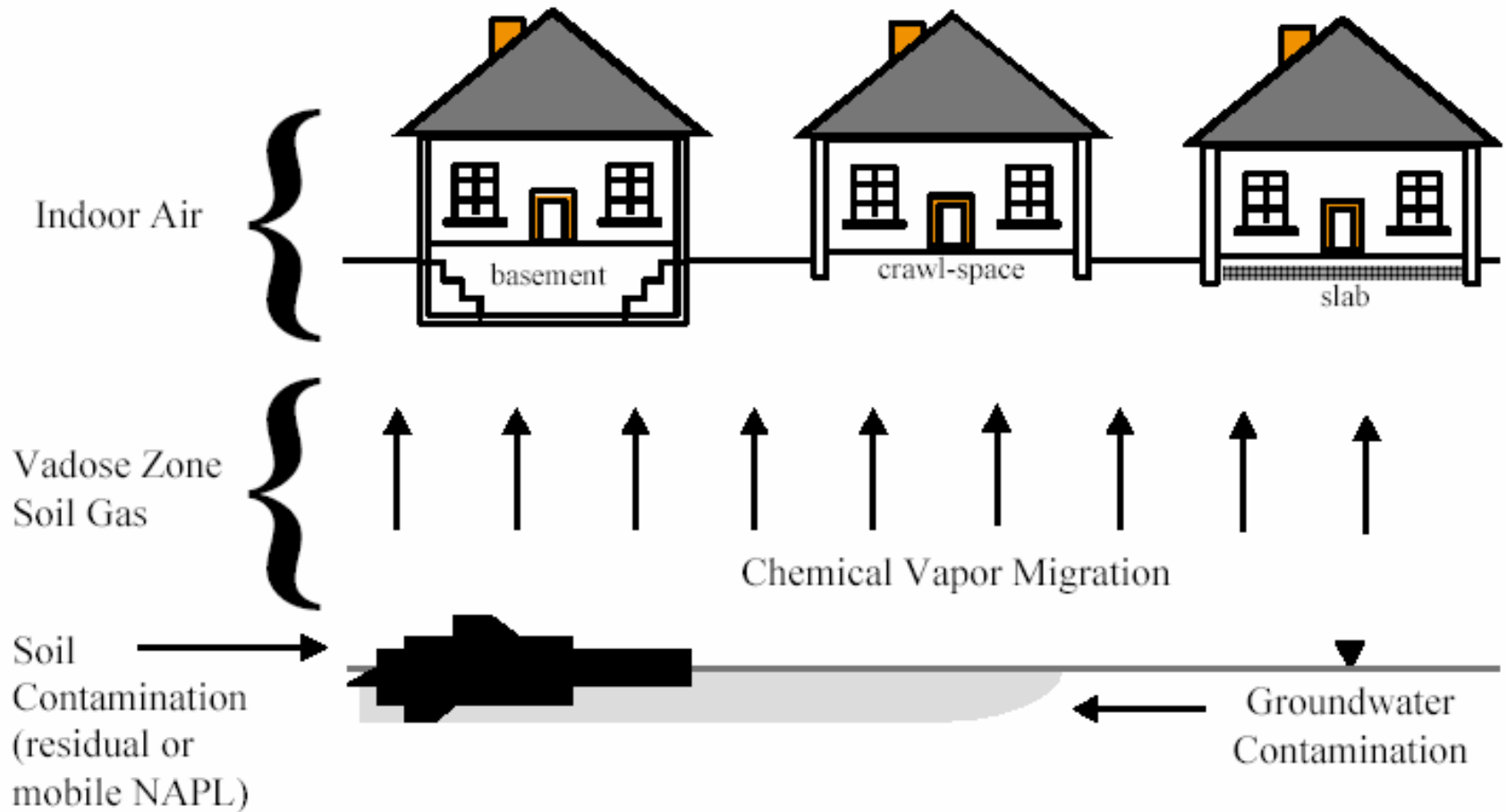
- Volatile Organic Compounds (VOCs), typically:
 - Perchloroethene (PCE; “Perc”)
 - Trichloroethene (TCE)
 - Benzene
- These VOCs are toxic and have low screening levels.
- Can be present in contaminated soil and groundwater as product/adsorbed/dissolved.



VI Mechanism

- VOCs migrate upward from impacted groundwater/soils into structures.
 - Diffusion from saturated/unsaturated zone;
 - Pressure/Temperature differentials;
 - Seasonal affects –indoor heating/stack effects
- Underground utility corridors can serve as a conduit for vapor migration.

VI Mechanism



(Source: U.S. EPA, 2002)

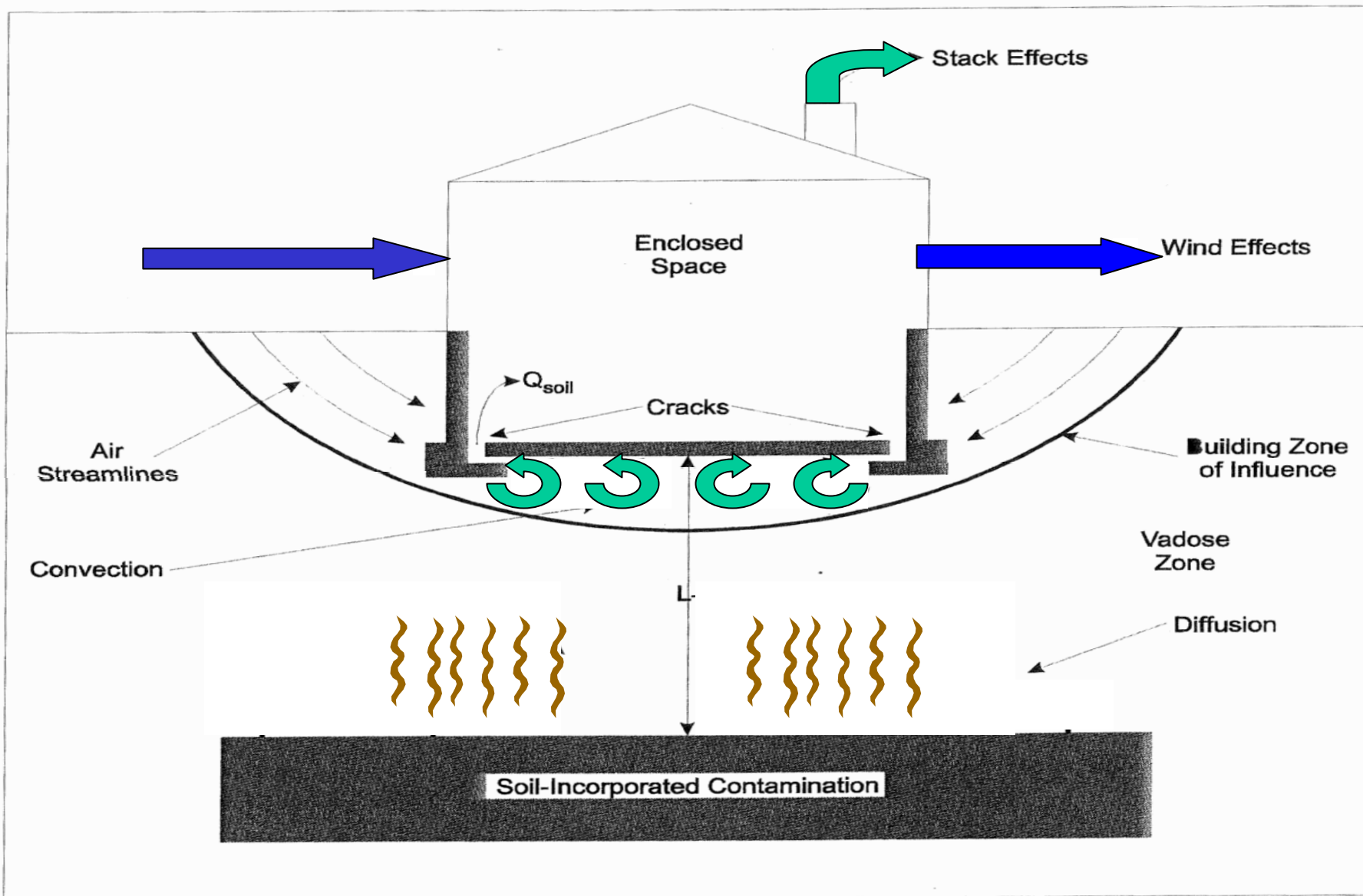


Figure 1. Pathway for Subsurface Vapor Intrusion into Indoor Air

(modified from U.S. EPA, 2003)



Building Factors that Affect VI

- Foundation material – dirt, crushed stone, dimension stone, concrete block
- Foundation construction: slab, crawlspace, basement
- Penetrating features – sumps, sewer/water lines, etc.
- Building air exchange rates – wind, building tightness, HVAC configuration, vents



What Sites Could Be Susceptible to VI?

- Contaminated sites that contain structures or may contain structures in the future.
- Properties adjacent to or in the vicinity of contaminated sites.
- Off-site properties are susceptible to VI due to:
 - Groundwater migration
 - Subsurface utility corridors



Why is VI being studied now?

- Exposure to VOCs in indoor air presents potential risk to human health.
- Recent studies suggest that this exposure risk may be more significant than previously thought.
- Required for regulated clean-up sites.
- Until recently (last 10 years), there was little focus on the VI exposure pathway (lack of research).



Difficulty in Evaluating VI Pathway

- Many variables (soil types, contaminants, seasonal effects, building construction, etc.).
- Difficulty in accounting for background conditions.
 - Ambient (outside) air
 - Nearby industrial/commercial activities
 - Highways/major roads (benzene/BTEX)
 - Background within structure
 - smoking (benzene/BTEX);
 - dry-cleaned clothes (PCE);
 - cleaning compounds and other household products (PCE, TCE, benzene, and other VOCs).
 - stored fuel, paints, etc. (attached garage)





VI Historical Perspective

- 1980s and early 1990s - U.S. EPA radon studies.
- Early 1990's – increased EPA awareness of VI; initial VI models developed.
- Late 1990s early 2000s – several high-profile sites.
 - Redfield Site in Colorado
 - Endicott Site in New York



VI Historical Perspective (cont.)

- December 2001 – U.S. EPA - Supplemental VI Guidance (for Human Health Environmental Indicator).
- November 2002 – U.S. EPA - “Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway From Groundwater and Soils”.
- Various states have followed U.S. EPA and developed VI guidance/program (e.g., CO, NY, NJ, MA, PA).



U.S. EPA Draft VI Guidance (November 2002)

- Establishes generic indoor air target levels for various VOC constituents.
- Provides generic target screening levels for groundwater and soil gas based on attenuation of VOCs from source to indoor air.
- Assumes residential scenario.
- Draft VI Guidance follows a tiered approach –
 - Tier 1 – COCs; Potential for VI (Are there structures...?).
 - Tier 2 – Use site-specific groundwater/soil gas data – compare to generic target levels.
 - Tier 3 – Soil gas, sub-slab, and/or indoor air sampling/additional modeling.



Projects Affected by VI

- Due Diligence/Property Transactions
- Brownfields
- State Cleanup Sites
- Voluntary Programs
- LUST
- RCRA/CERCLA Projects



Examples of Recent VI Issues in Indiana

- Example 1: Former printing shop in Commercial area (Brownfield)
- Example 2: Former Manufacturing Facility (EPA Region V - RCRA)
- Example 3: Residential Housing Development (Due Diligence)

September 21, 2005

Far-Southside residents worry about solvent in soil

Possible health risk has yet to be determined, officials say

By Paul Bird and John Tuohy

paul.bird@indystar.com

Edith Mitchell drives around her Cedar Park subdivision on the Far Southside and almost snarls behind the protective mask she wears over her face.

Popping out from several lawns are 5-foot-tall white pipes monitoring a potentially harmful industrial solvent in the soil.



⊕ zoom

Worried: Edith Mitchell wears a mask when she's outside in her subdivision, which is contaminated with TCE. - Charlie Nye / The Star

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The discovery last year of the solvent, known as TCE, or trichloroethylene, is killing off the Perry Township subdivision even before it's finished, Mitchell, 62, said. People are moving out before they sell their homes; new buyers can't get loans for homes in the subdivision; and the developer has stopped building until testing of the soil is finished.

Mitchell, who uses an oxygen tank for a respiratory condition and wears the face mask as a precaution while in the subdivision, bought her Perry Township home 2 1/2 years ago for \$139,800.

"See those two homes? They're for sale and, oh, there's a couple of empty lots with some nice weeds," Mitchell said during a drive through the area. "My home isn't worth anything anymore."

During a meeting among residents, developers, engineers and environmental experts Tuesday, officials said it may take years before they are 100 percent sure that residents will be safe from groundwater contaminants and the hazardous gases that could be coming from the soil.

"Whether or not it is a health risk is yet to be determined," said LaNetta C.



Vapor Intrusion Evaluation

- Evaluate existing soil and groundwater data.
- Collect additional data:
 - Soil gas samples;
 - Sub-slab air samples (collected from below concrete slab) or crawlspace samples;
 - Indoor air samples.
- Sub-slab (or crawlspace) samples.
 - Eliminates interferences caused by ambient/background air.
 - Most direct measurement of VI potential.
- Soil gas and sub-slab sampling utilize small sampling ports and generally result in little disturbance.



Figure 1. Drilling through a slab

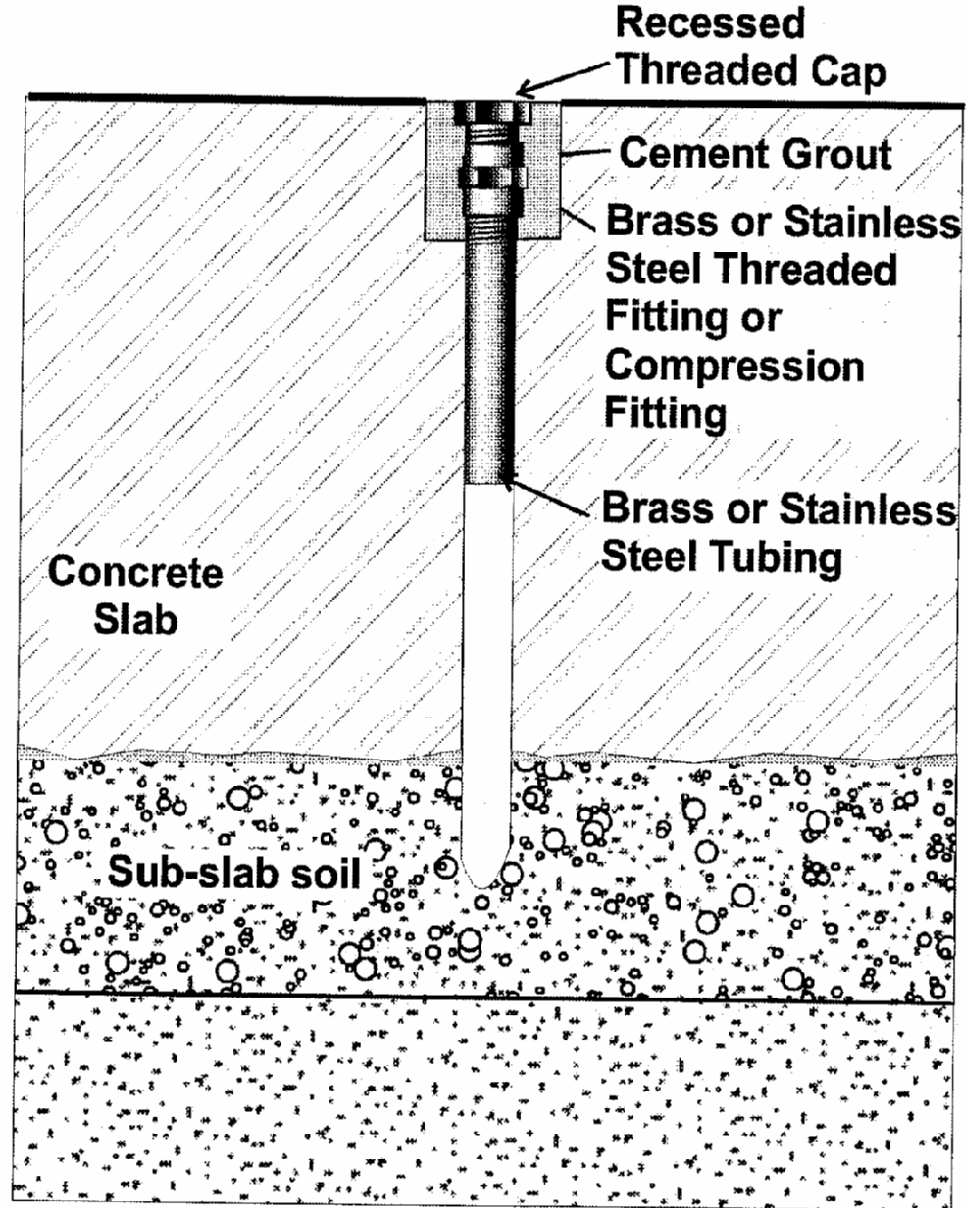


Figure 3. General schematic of sub-slab vapor probe



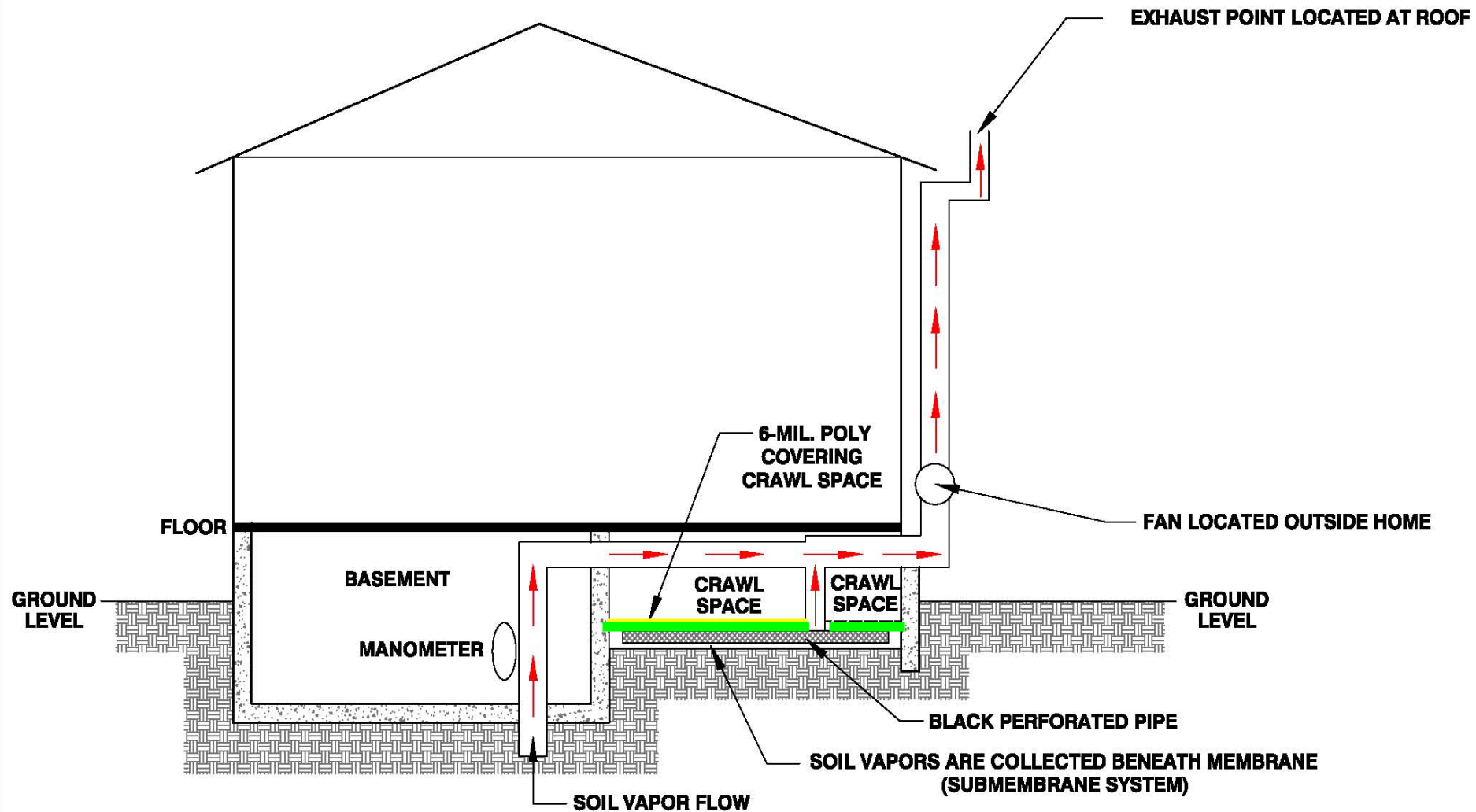
What to do if sampling suggests potential for VI?

- Additional sampling to ensure previous sample results
- VI mitigation
- Source control/remediation




VI Mitigation

- **Basement and Slab Construction**
 - Sub-slab mitigation:
 - Filling/repairing all cracks
 - Sub-slab depressurization system (similar to radon systems) – removes contaminant vapors from below slab
- **Crawlspace Construction**
 - Sub-membrane mitigation
 - Sealing crawlspace areas with plastic sheeting (i.e., membrane);
 - Sub-membrane depressurization systems (similar to radon systems).
- **Sub-slab/sub-membrane systems can remove >99% VOCs.**
- **Other mitigation options**
 - SVE
 - HVAC Reconfiguration
- **VI mitigation costs are typically \$1-3/per square foot.**



SOIL VAPORS ARE COLLECTED FROM BELOW CONCRETE SLAB (SUBSLAB SYSTEM)

 AUGUST MACK ENVIRONMENTAL, INC.			8007 CASTLETON ROAD INDIANAPOLIS, INDIANA 46250 (317) 579-7400 (317) 579-7410 FAX
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VAPOR MITIGATION SYSTEMS GENERAL DIAGRAM			
PROJECT No.:	FILENAME:	DATE:	



VACUUM MACHINERY OR
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Example of Liner System in New Commercial Construction





Resources for VI Mitigation Include

- “Radon Mitigation Standards”, EPA 402-R-93-078, October 1993 (Revised April 1994)
- “Building Radon Out: A Step-by-Step Guide on How to Build Radon-Resistant Homes”, EPA 402-K-01-002, April 2001



Final Thoughts

- VI is a rapidly developing issue.
- VI is on the radar screen of EPA and many states.
- VI will likely affect future transactions and closures; brownfields.
- IDEM will be implementing a VI Pilot Program in near future.



Vapor Intrusion

Questions & Answers

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